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PATENT SPECIFICATION 1,033,458

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to Swimming Pool Monitors.

We, SONUS CORPORATION, a corporation organized and existing under the laws of the Commonwealth of Massachusetts, United States of America, of 199 Alewife Brook Parkway, Cambridge, Massachusetts, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a swimming pool monitor. It relates more particularly to a swimming pol monitor capable of detecting sounds and turbulence caused by children or animals jumping or falling into an unattended swimming pool and giving a warning signal in response thereto. In addition, the monitor permits someone at a remote location to actually listen to the goings on at the pool and thereby determine the nature of the disturbance and extent of the emergency.

One difficulty with conventional swimming pool monitor or alarm systems is that while many of them are able to sound an alarm when someone or something jumps or falls into the pool, they do not discriminate between an actual emergency and other disturbances. That is, when they sound an alarm, there is no way for one to determine, without going to the pool, what the object that entered the pool was, or whether there is indeed an emergency situation requiring immediate action.

Also, prior systems are often unable to discriminate between turbulence in the pool caused by wind, rain, falling twigs, etc., and turbulence produced by struggling children and animals. As a result the pool owner may be subjected to a considerable number of false alarms. If the sensitivity of the alarm is reduced, it may fail to register a true emergency.

Accordingly, the main object of this invention is to provide a swimming pool monitor capable of giving an immediate warning signal whenever an object enters intentionally or inadvertently an unattended swimming pool.

A further object of this invention is to provide a swimming pool monitor which, after sounding an alarm can be used to listen to the disturbance so that the pool owner can ascertain exactly what is happening by the sound emanating from, in and around the swimming pool. Moreover, with this feature of the invention, accidents can actually be prevented. For example, by operating the monitor in the listening mode, a mother can detect potential danger resulting from rough play in or near the pool without ever having to be physically present.

Accordingly, the present invention consists in a swimming pool monitor comprising an underwater microphone adapted to be submerged in said pool, said microphone producing electric signals in response to sound vibrations in the pool, alarm means, a detector circuit for actuating said alarm means only in response to signals from said microphone, a transducer for reconverting said signals into sound, means including a first switch connected to pass signals from said microphone alternatively to said detector circuit and to said transducer.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawing in which the single figure is a schematic diagram of a swimming pool monitor embodying the principles of the invention.

In general, the swimming pool monitor employs an underwater microphone or

[*Price 4s. 6d.*]

hydrophone 10 capable of being submerged in the swimming pool and picking up underwater vibrations. These vibrations may be caused by children or animals thrashing in the water or even by voices or other noises in and around the pool. The output of the hydrophone is coupled through a filter-preamplifier 12 and fed to a detector circuit 14 which senses the amplified signals. The detector circuit 14 actuates a switch energizing an oscillator-amplifier 18 circuit and the latter produces an audible alarm via an associated transducer in the form of a speaker 120. The alarm will continue until the detector circuit is manually reset by the pool owner, even though the initiating vibrations in the pool cease.

The swimming pool monitor also has provision for switching from the aforesaid alarm or warning mode to a listening mode whereby the amplified signals from the hydrophane 10 are caused to bypass the detector circuit 14 and are connected directly to the oscillator-amplifier circuit 18. In this listening mode the circuit 18 amplifies the input-signal and feeds it directly to loud speaker 120. Thus, someone listening to the monitor at a location remote from the pool can actually hear voices and other sounds emanating from around the pool and determine what is happening.

Filter circuits are provided in the preamplifier stage 12 of the monitor to shape the frequency response thereof depending on whether the monitor is in the alarm or listening mode. When the monitor is in the listening mode, the preamplifier 12 passes the full voice range of frequencies. On the other hand, when it is in the warning or alarm mode, high frequencies caused by sirens, whistles, etc. and low frequencies caused by thunder, traffic, etc. are filtered out so that the monitor is made less susceptible to false alarms. A sensitivity control compensates for the ambient background noise level that may be present around a given pool installation.

The invention is embodied in a simple unit which may be installed with a minimum of effort and powered by a conventional power supply indicated at 21 connected to the standard 110 volt a.c. house supply or, alternatively by batteries.

More specifically, hydrophone 10 is preferably one of the piezoelectric variety capable of producing electrical signals in response to sound vibrations impinging the transducer. The hydrophone 10 is adapted to be submerged in the swimming pool and supported below the water and away from the side of the pool by a bracket (not shown) attached to the side of the pool. A shielded coaxial cable 22 connects the transducer 10 with the filter-preamplifier 12 which is mounted along with the other elements of the monitor within a single cabinet conveniently located in the home of the pool owner.

The filter-preamplifier 12 has three transistor stages comprising three similar n-p-n transistors 24, 26 and 28. These transistors are connected in the common-emitter configuration and have bypassed emitter resistors. The collectors 30, 32 and 34 of the transistors are connected through resistors 36, 38 and 40, respectively, to power supply 21.

Resistor 38 is preferably a potentiometer having an adjustable center tap 42 whose adjustment controls the gain of the preamplifier 12. Specifically, the potentiometer 38 provides a means for controlling the sensitivity of filter preamplifier 12 so that the system responds only to those signals produced by sounds above the ambient or background noise level in the vicinity of the pool.

A coupling capacitor 44 and series resistance 46 are connected between the inner conductor of coaxial cable 22 and the base 48 of transistor 24. The outer conductor or sheath of cable 22 is grounded. A relatively small coupling capacitor 50 is connected between collector 30 of transistor 24 and the base input 52 of transistor 26. A single pole switch 54*a* and a relatively large capacitor 56 in series therewith are connected in parallel with capacitor 50. Switch 54*a* is movable between two positions, "A" and "L". When switch 54*a* is in the "A" position, the relatively large capacitor 56 is connected in parallel with the small capacitor 50. In the "L" position the branch containing the large capacitor 56 is open-circuited and the coupling between transistors 24 and 26 is entirely through the small capacitor 50.

There is a similar coupling arrangement between transistors 26 and 28. More particularly, a two-position switch 54*b* has its common terminal connected to the center tap 42 of potentiometer 38. Switch 54*b* operates between two positions or terminals, "A" and "L". A relatively large capacitor 58 is connected between the "L" terminal of switch 54b and the base 60 of transistor 28. A smaller capacitor 52 is connected between the "A" terminal and the base 60. In addition, a capacitor 64 is connected between the "A" terminal of switch 54*b* and ground. In practice, the switches 54*a* and 54b are ganged together and thus operate in unison.

When the switches 54*a* and 54*b* are in the "A" position, electrical signals produced by the transducer 10 in response to sound vibrations in the water are amplified by transistor 24 and coupled through the small capacitor 50 to transistor 25. The capacitance of the capacitor 50 is so related to the resistances associated therewith, that they

course, persist until the arrival of additional signals from filter-preamplifier circuit 12.

The relay switch 100*a* is a normally open, single pole switch. It is connected between the "A" and "L" terminals of a two-position switch 54*d* whose common terminal is connected to the power supply 21.

The "L" terminal of switch 54*d* is connected also through a resistor 108 to the collector 110 of an n-p-n transistor 112. Transistor 112 is connected in the common emitter configuration and has a conventional by-passed emitter resistor and stabilizing and biasing resistors of a conventional amplification stage much like those in filter-preamplifier 12.

A coupling capacitor 114 is connected between the "L" terminal of switch 54*c* and base 116 of transistor 112. When switch 54*c* is in the "L" position, the signals from filter-preamplifier 12 bypass the detector circuit 14 and are coupled directly to the base input 116 of transistor 112. However, when switch 54*c* is in the "A" position, no signals are fed to the base of transistor 112.

It will be apparent that the switch 54*d* and relay switch 100*a* control the power applied to transistor 112. When switch 54*b* is in the "A" position, power is applied to transistor 112 only when relay switch 100*a* is closed by the energizing of coil 100 in the detector circuit 14, but when switch 54*d* is in the "L" position, the relay switch 100*a* is bypassed and the voltage from power supply 21 is applied directly to transistor 112 independently of the state of the detector circuit 14.

The output from the collector 110 of transistor 112 is coupled through a capacitor 118 to the base 120 of a p-n-p transistor 122. Transistor 122 has its emitter 124 connected through a resistor 126 to the power supply 21. An a.c. path to ground is provided the emitter 124 through a capacitor 127. Resistors 128 and 130, in series between the power supply 21 and ground, form a voltage divider biasing the emitter 124 positive with respect to the base 120.

The primary winding of an output transformer 132 is connected between ground and the collector 134 of transistor 122. The transformer secondary is connected to speaker 120. A capacitor 136 is connected between collector 134 and the emitter 138 of transistor 112 to provide negative feedback.

An R—C coupling network indicated generally at 140 provides regenerative feedback between the collector 134 of transistor 122 and the base 116 of transistor 112. The feedback network 140 includes a capacitor 142 and a resistor 144 in series therewith, both of which are connected in parallel with a capacitor 146 between collector 134 and the common terminal of a single throw switch 54*e*. The switch 54*a* is movable between two terminals "A" and "L", the former of which is connected to the base 116 of transistor 112.

In practice, all of the switches 54 *a-e* are operated in unison between their "A" positions and their "L" positions. When switches 54 are in their "A" positions, the oscillator-amplifier circuit 18 functions as a conventional oscillator by virtue of the network 140. In this mode it can produce an audible whistle or squeal over speaker 20. It cannot oscillate, however, until the relay switch 100*a* closes to supply power to the first stage transistor 112. This occurs only when current flows in the relay coil 100 in detector circuit 14 pursuant to a change in state of the detector bistable circuit as described previously. Once the relay switch 100 closes as aforesaid, the circuit 18 will continue to produce a loud signal over speaker 20 thereby warning the pool owner that someone or something has fallen into or is struggling in the pool. The signal will continue until the relay switch 100*a* is opened, thereby disabling transistor 112. As mentioned previously, this is brought about by the pool owner or operator momentarily opening the switch 94 in the detector circuit 14.

When the switches 54 are in their "L" positions, on the other hand, power is supplied to transistor 112 regardless of the condition of detector circuit 14. The feedback loop 140 is open-circuited so that the circuit 18 functions as a conventional two-stage amplifier. The output signals from filter preamplifier 12 are coupled directly to the base 116 of transistor 112. They are amplified by circuit 18 and converted by the speaker 120 into audible sounds which reflect what is going on at the pool. It is a feature of this invention that when the monitor alarm sounds, the pool owner can turn the ganged switches 54 to their "L" positions and thereby determine the nature of the disturbance at the pool. This feature is particularly useful when the home owner is unable for one reason or another to rush immediately to the pool when the alarm sounds.

The monitor can also be operated for long periods of time in the listening mode with the switches 54 in the "L" position. Thus a housewife may listen to children playing in and around the swimming pool. If the play becomes too rough, signalling possible accidents at the pool, she can take appropriate action before the accident actually occurs. Of course, the monitor can be used also as a simple means of communicating between the area of the pool and the interior of the home.

It will be seen from the foregoing, then, that the swimming pool monitor not only gives a warning alarm when persons ap-

proach or enter the swimming pool without authorization, but also enables the home owner to listen to what is happening at the pool without being physically present there. When the alarm sounds, the home owner can switch to the listening mode of operation and thereby quickly determine the nature and seriousness of the difficulty, and be in a much better position to provide or summon the required assistance.

When the monitor is operating in the alarm mode, its response to sounds in the vicinity of the pool is limited to relatively narrow band of frequencies which have been found to be particularly indicative of people or animals falling into or struggling in water. Thus false alarms are substantially eliminated since the monitor is non-responsive to most spurious sounds and vibrations in and around the pool. However, when the monitor is operating in its listening mode, its response is altered to permit both high and low frequency sounds to be amplified and reproduced by the speaker 120. Accordingly, the monitor has excellent voice reproduction qualities in its listening mode.

The monitor is relatively easy to manufacture, using inexpensive yet reliable components, is easily installed, is powered by the usual house power supply, and requires substantially no maintenance or up-keep.

WHAT WE CLAIM IS:—

1. A swimming pool monitor comprising an underwater microphone adapted to be submerged in said pool, said microphone producing electric signals in response to sound vibrations in the pool, alarm means, a detector circuit for actuating said alarm means only in response to signals from said microphone, a transducer for reconverting said signals into sound, means including a first switch connected to pass signals from said microphone alternatively to said detector circuit and to said transducer.

2. A swimming pool monitor as defined in claim 1, including an amplifying circuit connected between said microphone and said first switch, a plurality of filter elements, a second switch, operative to connect selected ones of said filter elements into said amplifying circuit, the operation of said second switch coinciding with that of said first switch whereby said amplifying circuit has a relatively narrow pass band when said first switch is connected to said detector circuit and a relatively wide pass band when said first switch is connected to said transducer.

3. A swimming pool monitor as defined in claim 1, wherein said detector includes a bistable circuit which remains in one state until the arrival of signals from said transducer whereupon said bistable circuit switches to another state.

4. A swimming pool monitor as defined in claim 1, wherein said detector includes a bistable circuit, said bistable circut being normally n a first state, means connected between said first switch and said bistable circuit for imposing a second state on said bistable circuit in response to signals from said microphone, means for actuating said alarm means when said bistable circuit is in said second state, and reset means for returning said bistable circuit to said first state.

5. A swimming pool monitor as defined in claim 4, wherein said means for actuating said alarm means includes a diode passing only those portions of said signals tending to impose said second state on said bistable circuit.

6. A swimming pool monitor comprising a first transducer for positioning in the water in said pool, said first transducer producing electric signals in response to sound vibrations in the pool, a first amplifier connected to the output of said transducer, said first amplifier including a switch operative between two positions, a second amplifier connected to one position of said switch such that when said switch is in said one position, the input of said second amplifier is connected to the output of said first amplifier means for providing regenerative feedback in said second amplifier when said switch is in its other said position, a second transducer connected to the output of said second amplifier and a detector circuit connected to said other switch position and said second amplifier, said detector circuit causing said second amplifier to oscillate when said switch is in said other position only upon arrival of signals from said first transducer.

7. A swimming pool monitor as defined in claim 6, wherein said first amplifier is a filter-pre-amplifier having a relatively wide pass band response when said switch is in said one poistion and a relatively narrow pass band response when said switch is in said other position.

8. A swimming pool monitor as defined in claim 7, wherein the width of said narrow pass band is between 500—900 cycles and said filter-preamplifier substantially excludes signals below 2500 cycles and the width of the wide pass band covers substantially the entire voice range of frequencies.

9. A swimming pool monitor as defined in claim 6, wherein said second amplifier comprises at least a two stage amplifier and means including another switch for providing regenerative feedback in said second amplifier means when said switch is in said other position.

10. A swimming pool monitor as defined in claim 6, wherein said detector circuit comprises a bistable circuit, said bistable circuit being in one state, control means

connected between said bistable circuit and said other switch position for imposing a second state on said bistable circuit only in response to signals from said first transducer and thereby actuating said second amplifier, said bistable circuit remaining in said second state even after cessation of said signals and means for returning said bistable circuit to its said one state.

11. A swimming pool monitor as defined in claim 10, wherein said bistable circuit comprises two transistors, one of said transistors being normally conducting, the other of said transistors being normally cut off, and said control means includes a diode connected between said other switch position and said one transistor and a relay coil connected in the circuit of said other transistor.

12. A swimming pool monitor, substantially as hereinbefore described with reference to the accompanying drawings.

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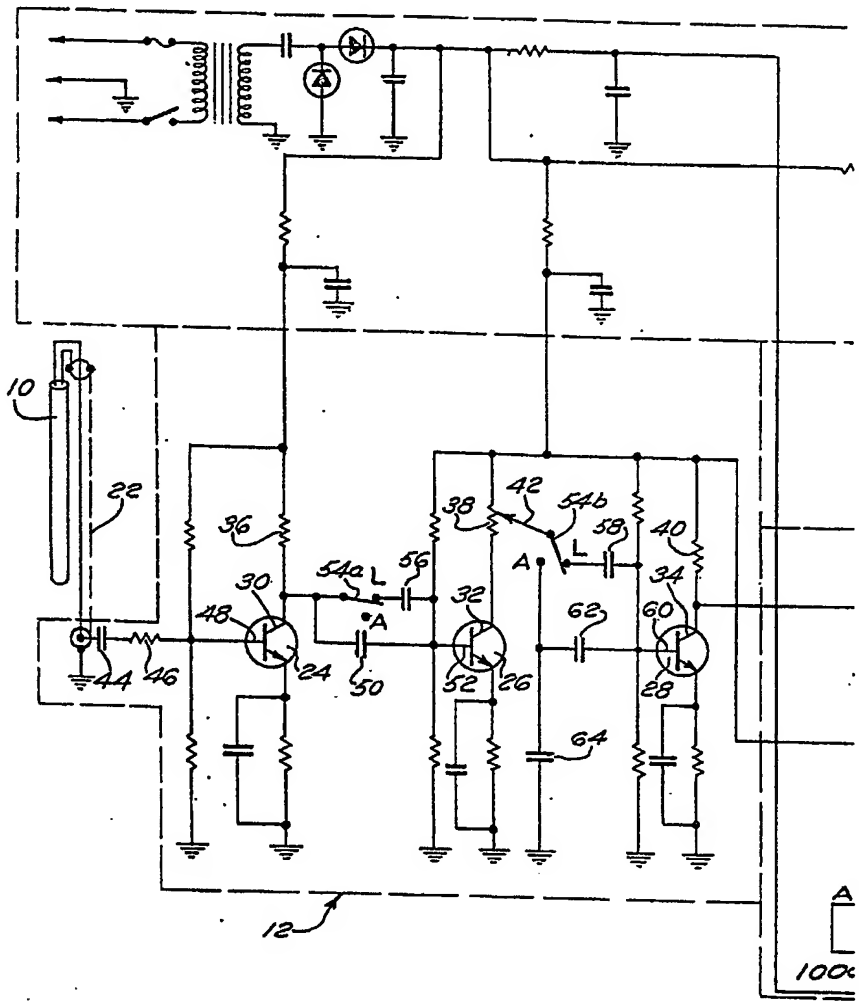
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1033458 COMPLETE SPECIFICATION
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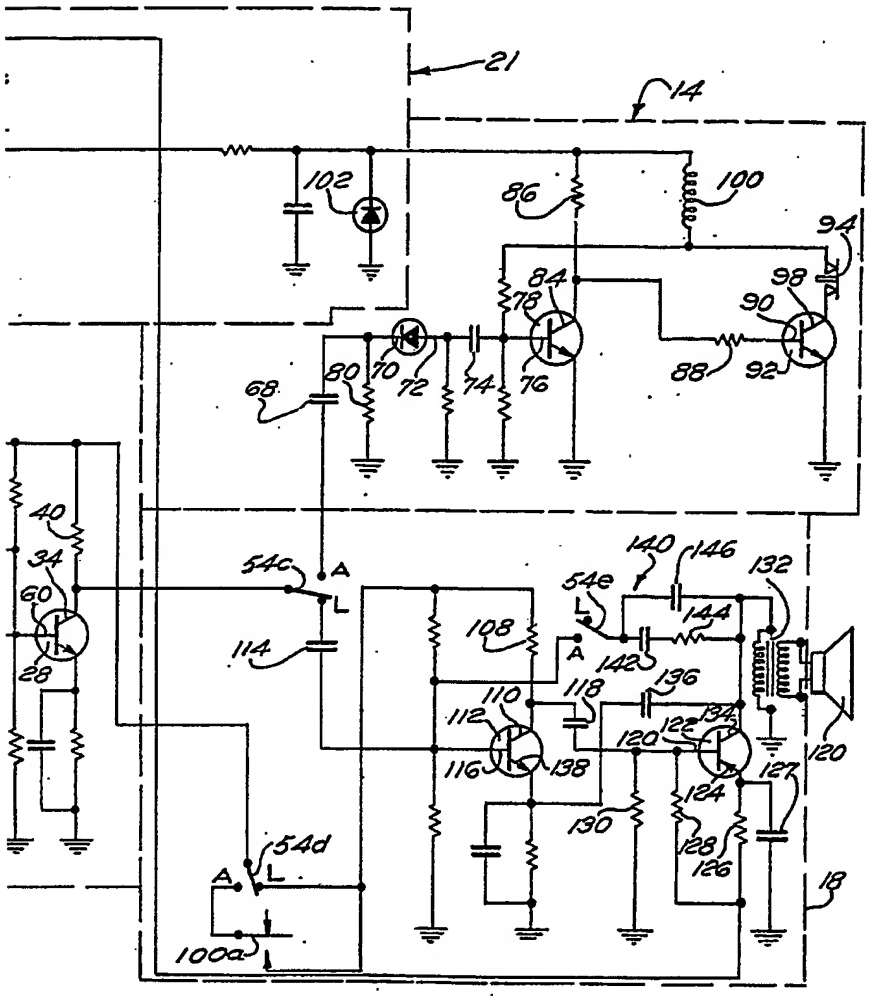

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